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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

KALAM, ABUL

ART UNIT

PAPER NUMBER

2814

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
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3 MONTHS

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/809,809	Applicant(s) IKUTA ET AL.	
	Examiner Abul Kalam	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 January 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-14, 16, 17, 19 and 21-24 is/are pending in the application.
- 4a) Of the above claim(s) 1-8, 12, 13, 16, 17, 19 and 21-24 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 9-11 and 14 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

forming a silicon oxide film (pg. 3: [0054]) over said silicon substrate (1, FIG. 2), said silicon oxide film having a thickness of 1.5 nm or less (pg. 3: [0054]); and introducing nitrogen into said silicon oxide film (pg. 3: [0054]) and displacing silicon atoms on a surface of said silicon substrate toward said gate insulation film side; and forming a high dielectric film constant film (4; pg. 3: [0055], pg. 4: [0063]) over said nitrogen-introduced silicon oxide film (3) by a deposition method without oxidation of said nitrogen-introduced silicon film (pg. 3: [0055], pg. 4: [0063]-[0064]), immediately after said step of introducing nitrogen and displacing silicon atoms (pg. 3: [0054]).

Regarding the recitation of "displacing silicon atoms on a surface of said silicon substrate toward said gate insulation film side," **Shimamoto** discloses that nitrogen is introduced into said silicon oxide film by the thermal treatment in an NO or N₂O atmosphere. Therefore, since the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established. *In re Best*, 562 F.2d 1252, 1255, 195 USPQ 430, 433 (CCPA 1977) and MPEP 2112.01.

Regarding **claim 10**, **Shimamoto** discloses the method wherein said step of introducing nitrogen and displacing silicon atoms comprises the step of conducting a first heat treatment to said silicon oxide film in an ammonia atmosphere or nitrogen monoxide atmosphere, (pg. 3: [0054]) .

DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of Species III, drawn to FIGs. 10A-11, in the reply filed on January 19, 2007 is acknowledged. Therefore, claims 9-11 and 14 read on the elected species and thus are given full consideration in this Office Action.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

1. **Claims 9-11 and 14** are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over **Shimamoto et al. (US 2004/0188762)**.

Regarding **claim 9**, **Shimamoto** discloses a manufacturing method of a semiconductor device (**FIGs. 2-4**) comprising the steps of:

forming a gate insulation film (**3 and 4, FIG. 2; pg. 3: [0052]**), over a silicon substrate (**1, FIG. 2; pg. 3: [0053]**); and

forming a gate electrode (**5, FIG. 3; pg. 3, [0057]**), over said gate insulation film (**3 and 4**), said step of forming a gate insulation film including the steps of:

Regarding **claim 11**, **Shimamoto** discloses the method wherein said gate insulation film is formed over a region where a conductive type of said surface of said silicon substrate is P-type (**pg. 3: [0051]-[0053]**).

Regarding **claim 14**, **Shimamoto** discloses the method according to claim 10, wherein said first heat treatment is conducted at 775 degree C or higher (**pg. 3: [0054]**).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. **Claims 9-11 and 14** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Roy et al. (US 2003/0186499)** in view of **Wang et al. (US 2003/0181012)**.

Regarding **claim 9**, **Roy** discloses a manufacturing method of a semiconductor device (**FIGs. 1-6**) comprising the steps of:

forming a gate insulation film (**14G, 28 and 32, FIG. 4; pgs. 2-3: [0023]-[0027]**), over a silicon substrate (**10; pg. 2: [0023]**); and

forming a gate electrode (**42, FIG. 5; pg. 4, [0029]**), over said gate insulation film (**14G, 28 and 32**),

said step of forming a gate insulation film including the steps of:

forming a silicon oxide film (14 in FIG. 1 or 14G in FIG. 2; pg. 3: [0025]) over said silicon substrate (10), said silicon oxide film having a thickness of 1.5 nm or less (pg. 2: [0023]); and

introducing nitrogen into said silicon oxide film (pg. 3: [0026]); and

forming a silicon nitride film (34, FIG. 4; pg. 3: [0027]) over said nitrogen-introduced silicon oxide film (28; pg. 3: [0026]) by a deposition method without oxidation of said nitrogen-introduced silicon film (pg. 3: [0027]), immediately after said step of introducing nitrogen (pg. 3: [0054]).

Therefore, **Roy** teaches all the limitations of the claim with the exception of disclosing "displacing silicon atoms on a surface of said silicon substrate toward said gate insulation film side."

However, **Wang** teaches a method of making a semiconductor devices wherein a gate insulation film is formed by introducing nitrogen into a silicon oxide film, wherein the nitrogen is introduced by a heat treatment in an ammonia (NH₃) atmosphere (pg. 4: [0047]). Thus, regarding the limitation of "displacing silicon atoms on a surface of said silicon substrate toward said gate insulation film side," **Wang** teaches a method substantially identical to that of the applicant's, for introducing nitrogen into a silicon oxide film, which causes the displacement of silicon atoms on said silicon substrate. Therefore, since the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of obviousness has been established. *In re Best*, 562 F.2d 1252, 1255, 195 USPQ 430, 433 (CCPA 1977) and MPEP 2112.01.

Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the process of Roy by introducing nitrogen using heat treatment in NH_3 atmosphere, as taught by Wang, instead of a remote plasma nitridation (RPN), which is taught by Roy. Wang teaches that NH_3 nitridation is preferred over RPN, because it keeps the gate oxide essentially unchanged in physical thickness, thus improving device miniaturization and performance (**pgs. 3-4: [0046]**).

Regarding **claim 10, Wang** discloses wherein said step of introducing nitrogen and displacing silicon atoms comprises the step of conducting a first heat treatment to said silicon oxide film in an ammonia atmosphere or nitrogen monoxide atmosphere, (**pg. 4: [0047]**) .

Regarding **claim 11, Wang** discloses wherein said gate insulation film is formed over a region where a conductive type of said surface of said silicon substrate is P-type (**pg. 4: [0047]**).

Regarding **claim 14, Wang** discloses wherein said first heat treatment is conducted at 775 degree C or higher ("**900°C**"; **pg. 4: [0047]**).

Response to Arguments

3. Applicant's arguments with respect to claims 9-11 and 14, filed on November 3, 2006, have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Abul Kalam whose telephone number is 571-272-8346. The examiner can normally be reached on Monday - Friday, 9 AM - 5 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on 571-272-1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2814

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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PRIMARY EXAMINER